

ATS-N/MA: Part III: Manner of Operations

Item 11: Trading Services, Facilities and Rules

a. Provide a summary of the structure of the NMS Stock ATS marketplace (e.g., crossing system, auction market, limit order matching book) and explain the means and facilities for bringing together the orders of multiple buyers and sellers on the NMS Stock ATS.

AlphaX US is a non-displayed trading venue limited to broker-dealer Participants, and makes available for trading all Regulation NMS common stock, ETPs and ADRs. AlphaX US operates periodic batch auctions at designated time intervals of ~~40~~ 40 milliseconds +/- a randomized increment up to ~~40~~ 20%, which is described in more detail in Part III, Item 11c. Matching priority is determined on a price/time basis, constrained by Participant Parameters, which are counterparty selection and minimum execution quantity.

c. Explain the established, non-discretionary rules and procedures of the NMS Stock ATS, including order interaction rules for the priority, pricing methodologies, allocation, matching, and execution of orders and trading interest, and other procedures governing trading, such as price improvement functionality, price protection mechanisms, short sales, locked-crossed markets, the handling of execution errors, and the time-stamping of orders and executions.

Periodic Auctions

Upon receipt, a firm order is placed in AlphaX US's order book and will be included in all Match Events for the life of the order, as long as the order is marketable at the time of the Match Event. The Match Events (i.e., auctions) in each security are automatic, and occur at scheduled times as determined by AlphaX US's matching algorithm throughout the day and are calibrated separately by each Match Event.

Each Match Event acts independently of each other. The description below sets out how AlphaX US determines the time between Match Events, and how AlphaX US calibrates this time for each Match Event.

Match Event Intervals and Match Event Process: AlphaX US randomizes the time between Match Events within a time range of a base of ~~40~~ 40 milliseconds and a randomized increment up to ~~40~~ 20% on either side ("Match Event Intervals"). The Match Event Interval is comprised of a static base time period ("Base Time Period") and a randomized time increment as a percentage of the Base Time Period (the "Randomized Time Increment"). After configuring the Base Time Period and the Randomized Time Increment, there ~~There~~ is no human intervention or discretion involved in the timing of these Match Event Intervals. Match Event Intervals are calibrated on a security-by-security basis. Each security enters its first Match Event upon the primary market opening and a quote and LULD bands being available in the security. The Match Event Interval (i.e., the duration of time until the next Match Event) is randomized to avoid a pattern that other Participants could detect. Once a Match Event concludes, the new Match Event Interval commences immediately.

There is no defined time for a Match Event; however, a Match Event will not exceed five microseconds. At the start of a Match Event, all marketable orders in the order book for a given

security will be ranked, based on price/time priority. Once a Match Event begins, any new orders will be queued and will not be eligible to trade until the next Match Event. Prices are locked for the order book at the start of the Match Event. The matching engine identifies any imbalance in marketable order quantity on the order book at that time. Whichever side holds the lesser of an imbalance (i.e., the lower number of marketable shares on the order book) determines the matching order. If there is no imbalance (i.e., there is an equal number of marketable shares on both sides of the order book), AlphaX US will begin the matching process using the side of the order book that has time priority (i.e., whichever side of the order book that has the marketable order with the lowest order sequence number). Price, capped by NBBO to the second decimal point (with the exception of sub-dollar priced stocks, which are capped to the fourth decimal point), is the leading factor in priority of orders matched; however, this is constrained by any PP on the order that may limit availability on the other side.

As an example, if the match begins on the buy side and the order with the most aggressive price is identified, AlphaX US will move to the sell side. If the most aggressive price on the sell side is an order for 300 shares and the buy side order AlphaX US is matching has a minimum execution quantity of 500 shares, AlphaX US cannot match these orders, and will move to the next most aggressively priced order on the sell side. In the event of two orders with the same price and no eliminating factors due to PP, the time of order receipt, as denoted by the sequence number assigned to the order, is the tie breaker, and becomes the deciding factor. There may be multiple matches at the end of a Match Event, as the matching engine logic matches as many shares as possible, given price levels and PP. At the conclusion of a Match Event, all AOC orders that were not fully filled are canceled, and all Day orders (including conditional orders) that were not fully filled remain live in the AlphaX US order book for the next Match Event.

Self-Trade Prevention

AlphaX US provides a self-trade prevention ("STP") setting for its Participants. This setting is not enabled by default, but can be enabled upon request.

Short Sales and Regulation SHO

AlphaX US's Participants are limited to U.S. registered broker-dealers that are obligated to comply with Regulation SHO Rule 203(b)(1), and pursuant to this rule, each short sale order must specify that a locate has been obtained. For short sale orders subject to Rule 201 under Regulation SHO, the AlphaX US

matching engine will prevent any orders from executing at the SIP NBB.

Locked or Crossed Market & Limit Up / Limit Down

AlphaX US uses SIP data for pricing information and does not match orders if the inside market for a stock is crossed (i.e., the market's best bid price exceeds the market's best ask price) or locked (i.e., the market's best bid price equals the market's best ask price). For all eligible securities, AlphaX US only executes if the LULD bands are present, and the effective price of a potential match is not constrained by a LULD band.

Pricing Methodology

Orders are matched at the midpoints of the buyers' and sellers' order book prices at the time of the Match Event, which are capped at the NBBO, as obtained from the SIP.

This results in an opportunity for price improvement for the Participants. All such price improvement is split on a 50/50 basis between buyers and sellers (based on the book prices of the orders). The only exception to price improvement is when Midpoint Peg orders match against other Midpoint Peg orders, and execute at the NBBO midpoint price at time of the Match Event. A single Match Event can result in multiple executions at different prices.

Execution Errors

AlphaX US reviews trade exceptions, and in accordance with the Participant Agreement, maintains the right to adjust or cancel clearly erroneous trades. In the event of a bona fide erroneous trade (as defined by FINRA Rule 11891 - Clearly Erroneous Transactions in Exchange Listed Securities), or in the event of an error by AlphaX US or a Participant, a Registered Principal of AlphaX US determines the best course of action, given the circumstances of the trade, and determines whether to cancel both sides of the trade, adjust price, or let the trade stand. Such decision is determined using relevant rules, and the AlphaX US internal trading policies. In the event a clearly erroneous trade needs to be adjusted or canceled, AlphaX US will contact the Participants involved, to inform them of the ruling.

Trade Examples

1. Example of pricing methodology:

a. NBBO of ZVZZT is 153.74 at 153.85

b. Buy order in the order book at time of Match Event:

i. 100 Shares of ZVZZT at 153.79

c. Sell order in the order book at time of Match Event:

	<p>i. 100 Shares of ZVZZT at 153.77</p> <p>d. The execution occurs at the midpoint of the buyer and seller limit prices, and 100 shares prints at 153.78.</p> <p>2. Example 2 of pricing methodology:</p> <p>a. NBBO of ZVZZT is 153.74 at 153.85</p> <p>b. Buy order in the order book at time of Match Event:</p> <p>i. 100 Shares of ZVZZT at 153.79</p> <p>c. Sell order in the order book at time of Match Event:</p> <p>i. 100 shares of ZVZZT at 153.70</p> <p>d. Since the limit price of the sell order is outside the NBBO, we cap the limit of the sell order at the NBB of 153.74, and the Book Price for the sell order in the Match Event is 153.74</p> <p>e. The execution occurs at the midpoint of the buyer and seller Book Prices, and 100 shares prints at 153.765.</p> <p>3. Example 1 of Price/Time Priority:</p> <p>a. NBBO of ZVZZT is 153.74 at 153.85</p> <p>b. Buy orders in the order book at time of Match Event:</p> <p>i. 500 shares at a limit of 153.79; arrived at 9:33:001, no PP attached to the order</p> <p>ii. 700 shares at a limit of 153.78; arrived at 9:33:30, no PP attached to the order</p> <p>iii. 600 shares at a limit of 153.74; arrived at 9:33:301, no PP attached to the order</p> <p>c. Sell order in the order book at time of Match Event:</p> <p>i. 2,800 shares at a limit of 153.75; arrived at 9:33:005, no PP attached to the order</p> <p>d. Once a Match Event begins, any new orders will be queued and will not be eligible to trade until the next Match Event. Prices are locked for the order book at the start of the Match Event - i.e., a "Midpoint Peg" order will be translated to the current midpoint price at the start of the Match Event.</p> <p>e. The Match Event begins with the smaller side of the imbalance, which in this case is the buy side (total order size in the order book is 1,800 shares on the buy side versus 2,800 on the sell side). First priority is price and the buy order with the most aggressive price is Order #1 with a price of 153.79. This trade will match at 153.77, the midpoint of the buyer and seller book prices. There are still shares on the sell side available, so AlphaX US will move to the next best price on the buy side, which is Order #2 at 153.78. These two orders will match and 700 shares print at 153.765, the midpoint of the buyer and seller book prices for these two orders. AlphaX US goes to the next buyer with a limit of 153.74. This buyer cannot match with the available seller due to its price limits. AlphaX US has matched all possible orders in this Match Event, so two sets of matched orders are executed, and the Match Event Interval begins for the next Match Event.</p>
--	--

f. The orders with an open quantity at the conclusion of the Match Event will remain on the order book and be available for subsequent Match Events.

4. Example 2 of Price/Time Priority, Constrained by PP:

a. NBBO of ZVZZT is 153.74 at 153.85

b. Buy orders in the order book at time of Matching Event:

i. 500 shares at 153.84; restricts participation to a specific counterparty (BDABC); arrived at 9:33:01

c. Sell orders in the order book at time of Matching Event:

i. 500 shares at 153.82; arrived at 9:33:015, no PP attached to the order

ii. 500 shares at 153.83; Order is from BDABC; arrived at 9:33:02

d. The Match Event begins with the smaller side of the imbalance, which in this case is the buy side (total order size in the order book is 500 shares on the buy side versus 1,000 on the sell side). There is only one buy order, so AlphaX US starts with that order for matching. First priority is price, so Order #1 on the sell side is the more aggressive price. However, there are PP that prevent this match. The buyer has specified the counterparty it wants to interact with and Order #1 on the sell side is from a different Participant. AlphaX US moves to the next sell order, which is from BDABC, the same counterparty the buy order has requested to trade with. AlphaX US is able to match Order #1 on the buy side with Order #2 on the sell side, and print 500 shares at 153.835 (the midpoint between the buyer and seller book prices). AlphaX US has matched all possible orders in this Match Event, so the trade is executed, and the Match Event Interval begins for the next Match Event.

e. The order with an open quantity at the conclusion of the Match Event will remain on the order book and be available for subsequent Match Events.

5. Example 3 of Price/Time Priority:

a. NBBO of ZVZZT is 153.74 at 153.85

b. Buy orders in the order book at time of Match Event:

i. 500 shares at 153.84; arrived at 9:33:01, no PP attached to the order

ii. 700 shares at 153.84; arrived at 9:33:05, no PP attached to the order

c. Sell orders in the order book at time of Match Event:

i. 500 shares at 153.82; arrived at 9:33:015, no PP attached to the order

ii. 500 shares at 153.83; arrived at 9:33:02, no PP attached to the order

d. The Match Event begins with the smaller side of the imbalance, which in this case is the sell side (total order size in the order book is 1,200 shares on the buy side versus 1,000 on the sell side). First priority is price, and the more aggressive seller is Order #1 on the sell side, so AlphaX US starts the

match with 500 shares to sell at 153.82. Moving to the buy side, there are two orders with the same price. Order #1 on the buy side arrived first, so AlphaX US matches 500 shares at 153.83 (the midpoint of the buyer and seller book prices). AlphaX US then moves to the next sell order and tries to match that. AlphaX US can in fact make a second match, so Seller #2 matches with Buyer #2 at 153.835 (the midpoint of those two orders). AlphaX US has matched all possible orders in this Match Event, so two sets of matched orders are executed, and the Match Event Interval begins for the next Match Event e. The order with an open quantity at the conclusion of the Match Event will remain on the order book and be available for subsequent Match Events.

Procedures for Midpoint Peg Order Ranking and Execution:

- a. AlphaX US accepts midpoint and non-midpoint order types. Midpoint Peg orders are eligible to match with other Midpoint Peg orders, as well as non-Midpoint Peg orders in a Match Event.
- b. At the start of a Match Event, AlphaX snaps the NBBO for use in that Match Event.
- c. If an order is sent with both a Midpoint Peg order instruction and an explicit limit, AlphaX US will use the more conservative price for the Match Event. If the limit price is more conservative than the implicit snapped NBBO price, then AlphaX US uses the limit price as the book price for the Match Event. If the implicit snapped NBBO midpoint price is more conservative than the limit price, AlphaX US will use the Midpoint Peg order ranking procedures for the Match Event.
- d. If, at the start of a Match Event, the snapped NBBO midpoint is a valid tick (i.e., it is not a sub-tick increment), the Match Event proceeds as described in examples above, and the book price of Midpoint Peg orders will be the midpoint of the snapped NBBO for this Match Event. If, at the start of a Match Event, the snapped NBBO midpoint is not a valid tick (i.e., it is a sub-tick increment), the book price assigned to Midpoint Peg orders will be calculated by rounding the midpoint of the snapped NBBO passively (i.e., buy orders are rounded down, sell orders are rounded up).
- e. Matching then proceeds as described in Part III, Item 7a., as well as above in this Part III, Item 11.c. Specifically, all Midpoint Peg orders have the opportunity to obtain price improvement by matching with a non-Midpoint Peg order if one is available. The Match Event follows price/time priority, and if a Midpoint Peg order matches with a non-Midpoint Peg order, the orders will split price improvement equally, and the trade will be executed at the midpoint of the buyer and seller book prices.
- f. Once all matches have been identified through ranking at the assigned book price, any eligible Midpoint Peg orders remaining in the order book will match with one another, at the

snapped NBBO midpoint in use for this Match Event. Any PP constraints (counterparty selection and minimum execution quantity) will be taken into account, and in a case where there are multiple orders that could match, time will determine the priority of order matching.

g. A Midpoint Peg order that matches in AlphaX US will never execute at a price worse than the snapped midpoint of the NBBO for the Match Event. An example of Midpoint Peg matching follows.

6. Example of Midpoint Peg Order Ranking and Execution:

a. At the start of a Match Event, the NBBO is snapped and will be used for the entirety of the Match Event. NBBO of ZVZZT is snapped at 153.80 at 153.85

b. Buy order in the order book at time of Match Event:

i. 1,200 shares with a Midpoint Peg instruction and no additional price limit; arrived at 9:33:01, no PP attached to the order (Order #1)

c. Sell orders in the order book at time of Match Event:

i. 800 shares of a non-Midpoint Peg order with a limit price of 153.80; arrived at 9:33:015, no PP attached to the order (Order #2)

ii. 500 shares with a Midpoint Peg instruction and no additional price limit; arrived at 9:33:02, no PP attached to the order (Order 3)

d. Since the snapped NBBO midpoint for this Match Event is a sub-tick price of 153.825, AlphaX US passively rounds each Midpoint Peg order to obtain its book price for ranking. The buy order (Order #1) now has an order book price of 153.82, and the sell order (Order #3) now has an order book price of 153.83

e. The Match Event begins with the smaller side of the imbalance, which in this case is the buy side (total order size in the order book is 1,200 shares on the buy side versus 1,300 on the sell side). First priority is price, and the more aggressively priced order and only buyer is Order #1, so AlphaX US starts the match with 1,200 shares to buy at 153.82. Moving to the sell side, the most aggressively priced order on the sell side is Order #2, 800 shares at 153.80, so AlphaX US matches 800 shares of Order #1 against 800 shares of Order #2 at 153.81 (the midpoint of the buyer and seller book prices)

f. There are no more eligible orders priced more aggressively than the snapped NBBO midpoint price, so AlphaX US will now match any eligible Midpoint Peg orders at the implicit price of the snapped NBBO midpoint of 153.825

g. The remaining 400 shares of the buy order (Order #1) will now match against the remaining shares of the sell order (Order #3) at 153.825 in the same Match Event.

h. AlphaX US has matched all possible orders in this Match Event, so two sets of matched orders are executed, and the Match Event Interval begins for the next Match Event

	i. The order with an open quantity at the conclusion of the Match Event will remain on the order book and be available for subsequent Match Events
--	--